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Agriculture

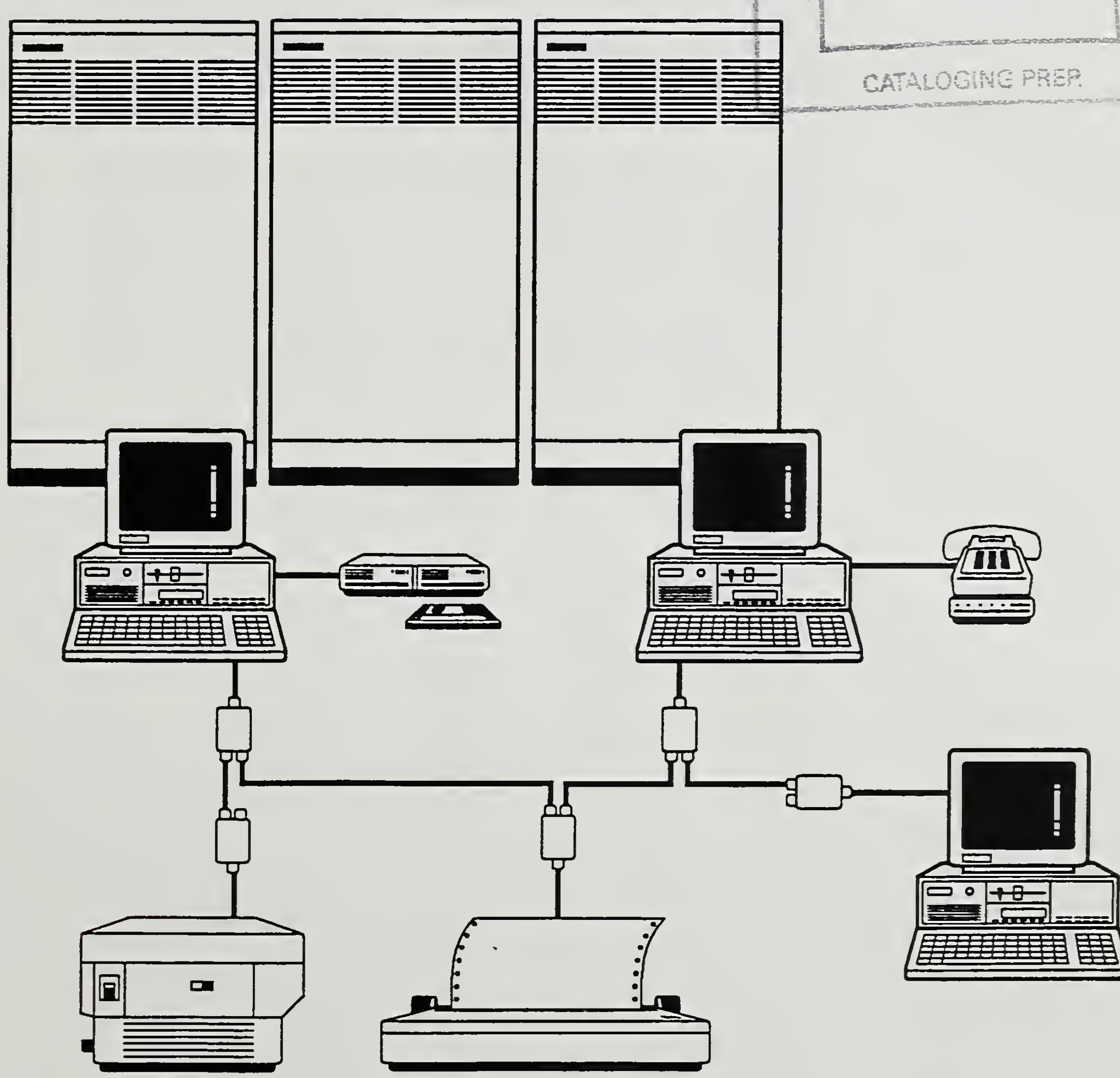
Food Safety and Inspection Service

Washington, DC

February 1993

FSIS Manual On Use Of Data Bases For Nutrition Labeling

FSIS Guidelines for the Effective Use of Data Bases to Develop Nutrient Declarations for Nutrition Labeling of Meat and Poultry Products



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Food Safety and Inspection Service
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PREFACE

This manual was prepared to provide guidance and practical information to meat and poultry product manufacturers who choose to use data base values or recipe analyses using these values to prepare nutrition label declarations for all or selected nutrients in their products. FSIS believes that use of data bases, alone or in conjunction with laboratory testing, will facilitate economic development of accurate labels to meet the requirements of FSIS nutrition labeling regulations and provide highly useful information to consumers for making dietary choices that benefit their health.

The document is intended to help establishments, especially those with limited experience with nutrition labeling or data bases, evaluate and effectively use data base values and systems to insure compliance with the regulations. The information presented was obtained from many sources. These include USDA publications and comments received from experienced data base developers and users in response to a supplemental proposed rule to allow for use of data bases to support nutrition label information. Also incorporated are the conclusions of an expert panel of government and industry scientists and nutritionists on the use of USDA Handbook No. 8 and other data bases for calculation of the nutrient content of meat and meat food products.

The scope of the manual is limited to applications involving previously derived nutrient values. It does not address sampling designs and analytical methodology employed in developing representative means for a product population nor statistical procedures for assessing nutrient variability of products.

Use of these guidelines does not negate a manufacturer's responsibility for the accuracy of its own label information. FSIS believes that by following the advice contained in this manual and by adhering to good manufacturing practices, companies can construct acceptable labels reflecting the average nutrient levels in products over time. In the event of problems which might surface during Agency compliance sampling, FSIS will work with affected parties to resolve discrepancies and tailor advice to ensure that nutrition labels based on data base values conform to the regulations.

Any questions about the contents of this manual may be referred to the Product Assessment Division, Regulatory Programs, at (202) 205-0080.

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INTRODUCTION

The Food Safety and Inspection Service (FSIS), U.S. Department of Agriculture (USDA), issued a proposed rule in the Federal Register on November 27, 1991 (56 FR 60302) to require the mandatory nutrition labeling of most multi-component, processed meat and poultry products and to permit and establish guidelines for voluntary nutrition labeling of single-ingredient, raw meat and poultry products. FSIS proposed to allow use of the most current representative values in USDA's National Nutrient Data Bank (NNDB) or its published form, the Agriculture Handbook No. 8 series (AH-8), for labeling of single-ingredient, raw products, without subjecting the labeling to compliance review in the absence of nutrition claims. The Agency also proposed that manufacturers could use other data bases, such as their own private values, for products falling into the voluntary category, but the labeling would be subject to compliance procedures.

Numerous commenters requested specific allowance for use of data bases to calculate nutrient profiles for multi-component, processed products to alleviate costs. Several companies submitted data validating the accuracy of the data base approach when compared to laboratory analyses on their products. In response, FSIS issued a supplemental proposed rule on March 5, 1992 (57 FR 10298) to permit use of data base values and/or recipe analysis based on data base values to develop labels for food products subject to mandatory nutrition labeling requirements. The Agency requested input on criteria for data bases, guidelines it could supply to manufacturers to use this approach effectively, and information about availability of data bases. The latter includes computer systems with software packages for recipe analysis, as well as data base files.

FSIS concluded that use of data bases, especially computerized systems, offers a powerful tool for developing nutrient declarations when used effectively. Consequently, the Agency specifically stated in the preamble to the final nutrition labeling rule published in the Federal Register on January 6, 1993 (58 FR 632) that nutrient declarations may be based on data base values, recipe analysis using data base values, direct analysis, and/or a combination of these approaches. FSIS also noted that the data base approach is a potentially complex issue involving considerations about accuracy, completeness, precision, and support. This manual was developed to share with manufacturers pertinent information and the many suggestions FSIS received in response to its proposals about these issues and about how to use data bases most effectively.

WHAT ARE NUTRIENT DATA BASES

A nutrient data base is a collection of nutrient values on individual food products, which is stored in machine readable form, such as on floppy or compact disks and magnetic tapes. The values can be accessed by computer programs, i.e., the software, as needed for recipe calculations. A nutrient data base system consists of the data base and software. Most commercial and many industry data bases include USDA data from the NNDB. Commercial sources offer different products, ranging from data bases that are copies of USDA's to those with greatly expanded coverage of brand name and ingredient products and/or additional nutrients.

Original analytical data in a reference data base, such as USDA's NNDB, usually consist of a large number of samples collected on many foods across seasons, geographic areas, breeds, cultivars, etc. Not all of this information is necessary for all applications so series of data sets of varying smaller sizes are prepared by combining data on like foods. Original data may be averaged for an identical food, e.g., for one brand of a particular condensed soup. Brand averages may in turn be combined or weighted by the market share of each to create a data base of generic nutrient values for the food product. A number of large industry data base systems, which have been built up over a period of years, also contain values reflecting numerous analytical data points on companies' products and ingredients.

When analytical data on samples of commodity-type products are combined or weighted with factors obtained from production or marketing statistics, results are frequently referred to as composite values. For example, USDA's composite of retail cuts for all grades of beef is a set of nutrient values weighted for both market share of quality grades of beef and the major cuts within the carcass. In addition to averages of results of laboratory analyses, USDA data bases contain calculated values based on laboratory measurements of cooking yields, retentions of nutrients during processing, and physical composition, such as proportions of flesh and skin on a poultry cut. Estimated values may be added to data bases when analytical data are missing. USDA data base values are intended to reflect the year-round, nationwide contribution of nutrients from foods.

The primary advantages of using good computerized data bases are that they can provide accurate values over time, offer the ability to build and tailor information, are relatively economical compared to extensive laboratory testing, and are very fast. A number of companies indicate that, because data base values reflect numerous analytical data points, they find that calculated values frequently are more accurate than an initial analytical test and that running several additional tests will verify the calculated values. Using ingredient data bases minimizes seasonal profile swings to more accurately represent

average nutritional composition year-round, whereas point analysis can vary across a range, depending on the conditions that exist at the time of manufacture of the food product.

Meat and poultry products that are minimally processed or contain a few standardized ingredients especially lend themselves to a national data base, such as AH-8. USDA conducts lengthy scientific reviews before information is approved for AH-8, which has contributed to it becoming a widely recognized reference on nutritional information. This creditable document is a natural source of meat and poultry labeling data. However, manufacturers do need to determine if generic values for ingredients are suitable or if supplier data are needed to reflect their own unique ingredients and/or specifications.

Companies generally recommend using recipe analysis to calculate nutrient content of multi-ingredient products, as opposed to using a generic finished product nutrient composition, e.g., for a pepperoni pizza, to represent their own products' profiles. When using recipe analysis, nutrients in the finished product are calculated as the sum of nutrients from quantities of ingredients according to a company's formula that is closely respected in processing, with appropriate adjustments for nutrient losses and gains associated with certain processing techniques.

Using calculated data works quite effectively in many situations, such as for products formulated from ingredients with relatively consistent or well-characterized nutrient profiles. Calculation of the nutrient content of complex mixtures, such as meals and entrees, is also possible. Most manufacturers indicate that the more complicated the formulation or processing steps and the greater the natural nutrient variability of the ingredients, the likelihood that calculated values might deviate from analytical results on the same product increases. Discrepancies most frequently occur with fat, cholesterol, sodium, potassium, vitamins A and C, and thiamin. Manufacturers of highly formulated products suggest performing periodic laboratory analyses to check data base calculations, especially for variable nutrients. Appropriate label values for different nutrients can be constructed using either the calculated or analytical values. When laboratory results differ from data base calculations, comparisons are very valuable in that they can be used to develop formulas, such as prediction algorithms or retention factors, to account for differences. Such factors and accumulated laboratory analyses, when built into data base systems, yield even more accurate nutrient values over time.

Significant cost savings and reduced turnaround times can be realized if accurate calculated data can be used exclusively or to supplement limited analytical data because nutritional analysis is very expensive and time consuming. A complete analysis for one product can cost up to $600 per sample and take

as long as 4 weeks to process. Analyses on several or more composite samples often are conducted on a new product to insure label accuracy since a single test represents only a snapshot of the food at the time of analysis. By contrast, food industry versions of many commercial data base systems cost less than $1,000 and, with timely updates, provide years of service. The cost to have a recipe calculation performed for a business by a data base vendor or consultant runs about $50 per formulation. Consequently, nutrient data bases can offer efficiencies to manufacturers and savings to both large and small firms and ultimately to consumers. Once a computerized data base system is set up and running, a calculation for label declarations can take as little as 15 minutes to complete. This speed of information translates to an accelerated timetable for launching new products and to enhanced market competitiveness.

MANDATORY AND VOLUNTARY NUTRIENTS

Under the final nutrition labeling rule, fourteen nutrients are required to be listed on nutrition panels on foods for adults and children 4 years or older. The mandatory (underlined) and voluntary dietary components and the order in which they appear are listed below. These are the only nutrients allowed on the nutrition panel. Vitamins and minerals, except sodium and potassium, are expressed as a percent of a Reference Daily Intake (RDI) and declared as percent of Daily Value. The RDIs also are listed below and are numerically equal to the U.S. Recommended Daily Allowances. If a claim is made about any optional component, its listing becomes mandatory.

<u>Nutrients</u>	<u>Units for Declarations</u>
<u>Calories</u>	Calories (kilojoules optional)
<u>Calories from Fat</u>	"
Calories from Saturated Fat	"
<u>Total Fat</u>	grams (g)
<u>Saturated Fat</u>	"
Stearic Acid	"
Polyunsaturated Fat	"
Monounsaturated Fat	"
<u>Cholesterol</u>	milligrams (mg)
<u>Sodium</u>	"
Potassium	"
<u>Total Carbohydrate</u>	grams (g)
<u>Dietary Fiber</u>	"
Soluble Fiber	"
Insoluble Fiber	"
<u>Sugars</u>	"
Sugar Alcohol	"
Other Carbohydrate	"
<u>Protein</u>	"

Vitamin A (% β-carotene optional)	% of 5,000 International Units
Vitamin C	% of 60 milligrams
Calcium	% of 1.0 gram
Iron	% of 18 milligrams
Vitamin D	% of 400 International Units
Vitamin E	% of 30 International Units
Thiamin	% of 1.5 milligrams
Riboflavin	% of 1.7 milligrams
Niacin	% of 20 milligrams
Vitamin B_6	% of 2 milligrams
Folate	% of 0.4 milligrams
Vitamin B_{12}	% of 6.0 micrograms
Biotin	% of 0.3 milligrams
Pantothenic Acid	% of 10 milligrams
Phosphorus	% of 1.0 gram
Iodine	% of 150 micrograms
Magnesium	% of 400 milligrams
Zinc	% of 15 milligrams
Copper	% of 2.0 milligrams

An insignificant amount of a nutrient is the amount per serving that rounds to zero, except that for total carbohydrate, dietary fiber, and protein, it is an amount less than 1 gram. The prescribed increments for reporting the nutrient information and levels that round to zero per serving of food are as follows:

- Calories: 5 Calories $\leq$ 50; 10 Calories > 50; < 5 Calories = 0.
- Fat and fatty Acids: 0.5 g < 3 g; 1 g > 3 g; < 0.5 g = 0.
- Cholesterol: 5 mg; < 2 mg = 0.
- Sodium and potassium: 5 mg $\leq$ 140 mg; 10 mg > 140 mg; < 5 mg = 0.
- Carbohydrate and subcomponents and protein: 1 g; < 0.5 g = 0.
- Vitamins and minerals: 2% $\leq$ 10%; 5% > 10% & $\leq$ 50%; 10% > 50%; < 2% = 0.

Labels of foods for adults and children 4 years or older must carry a listing of the percent of a Daily Reference Value (DRV) declared as a percent of Daily Value for six nutrients as follows:

Nutrients	DRV
Total Fat	65 grams
Saturated Fat	20 grams
Cholesterol	300 milligrams
Sodium	2,400 milligrams
Total Carbohydrate	300 grams
Dietary Fiber	25 grams

The percents are expressed to the nearest whole percent and calculated by dividing the actual amount (i.e., before rounding)

for each nutrient by its DRV. DRVs are also established for this age group for potassium at 3,500 milligrams and for protein at 50 grams. When protein is listed as a percent of its DRV and declared as percent of Daily Value, the actual amount of protein in grams is first corrected by multiplying the amount by its amino acid score corrected for protein digestibility.

There are a few nutrient definitions in the final rule that should be noted because the same nutrients, as contained in data bases, may not conform exactly to the definitions. This is not to imply that the differences are of a magnitude to have nutritional significance. It is not anticipated that all nutrients in data bases will conform to food labeling definitions in the near future.

- Total fat is defined as total lipid fatty acids expressed as triglycerides. As such, it excludes cholesterol. This definition is not synonymous with information in food composition tables but is not expected to yield results for most meat and poultry products that would be problematic.

- Saturated fat is now defined as the sum of all fatty acids without double bonds expressed as free fatty acids. This definition is the same as used in AH-8 and other food composition tables. However, it differs from the previous labeling definition of saturated fat as the sum of lauric, myristic, palmitic, and stearic acids expressed as triglycerides.

- Mono- and polyunsaturated fats are defined to include *cis*-monounsaturated fatty acids and *cis,cis*-methylene-interrupted polyunsaturated fatty acids (PUFA), respectively, and are expressed as the free fatty acids. Previously, PUFA had the same definition, and both types of fats were expressed as triglycerides. USDA food composition tables include positional and geometric isomers in these fatty acid totals so that the totals include *trans* isomers when present in a food.

- Total carbohydrate includes dietary fiber, which is a definition that is consistent with food composition values.

- Sugars are defined as the sum of free mono- and disaccharides. They represent total sugars, as opposed to added sugars, and include glucose, fructose, sucrose, lactose, and maltose. Sugars are not published in the AH-8 series at this time.

- Vitamin A is defined for labeling only in terms of retinol and β-carotene activities. In the preamble to the final rule, FSIS indicated that it accepts values when other vitamin A active carotenoids are also measured. Vitamin A values vary depending on the analysis technique, and it is suggested that values in some food tables and data bases may be high (*1*).

SOURCES OF NUTRIENT DATA BASES AND COMPUTER SYSTEMS

Major sources of nutrient data bases include the following:

- USDA data bases. The AH-8 series of food composition tables and machine-readable data sets are prepared by USDA's Human Nutrition Information Service (HNIS) and are publicly available. For the most part, USDA data bases contain generic values, as opposed to values for brand name products. The machine-readable data sets contain nutrient and other data, such as weights, and are unaccompanied by computer programs.

- Commercially available systems. Most nutrient calculation systems use USDA data as a foundation. Many supplement those values with brand name information obtained from manufacturers and other sources. The numerous systems contain programs for specific applications and target different audiences. Not all systems are aimed at industry applications or have recipe analysis features.

- Industry systems. These in-house systems are generally proprietary in nature and contain analytical data on company products, company-analyzed or supplier data on ingredients, and, often, USDA data, as well as data from other sources. Frequently, companies purchase a commercially available system and customize the data base.

Appendix Table 1 contains a listing of USDA's AH-8 series and ordering information for the hard copy publications from the Government Printing Office (GPO). Further information about USDA food composition data and publications may be obtained from HNIS at telephone number (301) 436-8491. USDA nutrient data bases are also available for purchase on track tape (some on floppy disks) from the National Technical Information Service (NTIS). No programs accompany the files. Details on these data sets can be found in HNIS Administrative Report No. 378 (*2*).

HNIS operates an electronic bulletin board as a public service to provide information about its current publications and computer files on the nutrient composition of foods. Information is presented in the form of bulletins that can be viewed directly or downloaded to disk for review at the convenience of users. USDA's nutrient data files, including most of those carried by NTIS, are available to download at no charge for use on computers using MS-DOS or PC-DOS. Among these are USDA's Nutrient Data Base for Standard Reference, which contains all of the data in the AH-8 series with some missing values filled in, data on the sugar content of selected foods, and data on retentions of nutrients during food preparation.

Nutrient data files currently available on the board for downloading are shown in Appendix Table 2. The board can be

accessed from an IBM compatible PC with a 1200 or 2400 baud modem and communication package. Recently, the service was extended to the Internet system. Use of the Internet counterpart allows much faster file transmission. The telephone number of the board is (301) 436-5078. Service is available 24 hours a day, 7 days a week, except for brief periods of maintenance. Questions about the board may be referred to HNIS at (301) 436-5635.

It is important to note that the AH-8-10 section on Pork Products has undergone a major revision of data for fresh cuts. FSIS does not recommend using data from the 1983 publication for labeling fresh pork cuts or for recipe analysis. The revised book was published in February 1993. The new nutrient values for fresh pork are incorporated into Release 10 of the USDA Nutrient Data Base for Standard Reference, which is posted on the HNIS bulletin board. A major revision of the 1980 AH-8-7 section on Sausages and Luncheon Meats is now in progress. Also, work is being initiated to develop standard calculation procedures for use in converting data for fresh beef and lamb cuts, which are currently shown in AH-8 at 1/4 inch external fat trim, to levels which reflect the current market practice of trimming these cuts to about 1/8 inch fat cover.

Options for manufacturers who currently do not have a nutrient data base, but who want to use a computerized system, include buying or leasing a developed system with the software and data base; accessing a system through a time-sharing arrangement, usually via remote terminal; or contracting for calculation services to be performed by a data base vendor, a food industry consultant, or a label expediting firm. For those interested in exploring the market, there are a large number of nutrient calculation software packages. These commercial systems range in scope from less than 10 to more than 100 nutrients; in food items from less than 100 to over 10,000; and, in price from less than $100 to about $11,000.

As noted previously, not all packages offer recipe calculation features, nor do all software programs run on all computers. The hardware choices are usually IBM and compatibles, Macintosh, Apple II, or mainframe, although some systems are available for more than one type of computer. Also, not all software packages allow the user to add food items and/or nutrients. Many vendors do provide demonstration packages to help potential users evaluate their software features. A recent compilation of numerous, important features of about 50 data base systems is contained in the 8th edition of the Nutrient Databank Directory, 1992, Jack L. Smith, editor. Copies are available for $17.00 each from the University of Delaware, Dept. of Nutrition and Dietetics, Alison Hall, Newark, DE 19715-3360.

The Food and Nutrition Information Center (FNIC) of USDA's National Agricultural Library (NAL) also has a collection of over

190 microcomputer software programs, a number of which contain nutrient analysis modules. This information is compiled in a FNIC Software List, which includes a brief description of the packages and a producer/distributor list. For information contact FNIC, NAL, Room 304, 10301 Baltimore Blvd., Beltsville, MD 20705. The FNIC telephone number is (301) 504-5719. In addition to the above mentioned sources of information, reviews of nutrient calculation software are published regularly in such journals as the Journal of the American Dietetic Association (*3*).

Appendix Table 3 contains a list of data base systems supplied by commenters on the supplemental proposed rule in response to FSIS' request for information on commercially available systems that might be of use to meat and poultry manufacturers for labeling their products. The list does not include all developers of commercial systems or consultant services. Mention of a firm does not constitute an endorsement by USDA of a listed system over others not mentioned. Manufacturers who elect to use a computerized system to develop nutrition labels should evaluate and select a system best suited to meet their own needs, taking into account types of products, ingredient formulations, and processing procedures employed.

CRITERIA FOR DATA BASES

Three basic criteria mark a good data base for food labeling - accuracy, completeness, and specificity. Systems meeting these criteria would include an accurate and up-to-date nutrient data base, be complete for the foods and nutrients of interest, and permit specificity with respect to food descriptions and processing procedures.

1. <u>Accuracy of the nutrient data base</u>. The nutrient data base component of a system is one of its most important features. Most commercial systems use one or more of the first three USDA nutrient data sets shown in Appendix Table 2 as a core, together with other ingredient information. FSIS believes that USDA's nutrient data for red meats and poultry products are especially useful for labeling because they are based on a considerable amount of scientific research. Additionally, data for all foods used to develop USDA's representative values have been evaluated by food composition specialists. Vendors of systems should be able to document the source(s) used in compiling their nutrient data bases so that users can have confidence in their quality.

Since many commercial systems are supplemented with other data, such as additional nutrients, common commercial ingredients used by the food industry in product formulations, and brand-specific manufacturers' products, the additions should be made with care. Data should undergo quality assurance procedures to verify accuracy and consistency, and data base developers should be able to provide information on procedures they use for this purpose.

Companies or trade associations developing or using their own ingredient composition data bases should also have procedures in place to ensure that nutrient values receive reviews, audits, and confirmation through nutrient analyses, if necessary.

It is widely recognized that commercial nutrient data bases need to be updated on a regular basis to ensure accuracy. Such maintenance should be done on a yearly schedule to incorporate the most recent releases of data sets available from USDA and from suppliers of ingredients. Any potential user should determine how current a data base under consideration is, and whether the most recent USDA data have been incorporated. When purchasing a system, it would be worthwhile to consider the arrangements available and projected cost for updates to the data base supplied with the system.

2. <u>Completeness of the data base for foods and nutrients</u>. To be of greatest use to a manufacturer, a data base should include all of the ingredients used in his or her own specific products and those nutrients required to be labeled. Most manufacturers would want the capability to add nutrient data for their own products and specialty ingredients, in which case they need a system that is expandable and allows for editing. In general, the size of a data base, in terms of the number of food items, should not be used as a major criterion of quality. Numbers can be inflated by carrying different brands, weights, and forms (shredded, cubed, etc.) of the same food, or by adding data haphazardly. Smaller data bases of a few hundred items are less costly and easier to use but may not provide the specificity needed to calculate complex, multi-ingredient recipes.

Potential users of computerized systems should find out from vendors if the ingredients and foods used in the manufacture of their own products are contained in or can be added to a data base when used at levels that contribute required nutrients to finished product profiles that would be reportable. When ingredients and foods are missing from a data base, substitution of similar items is an alternative. However, this approach increases the chance of distorting the calculated results. Completely ignoring an ingredient that is a source of a nutrient or the weight of an ingredient with only optional nutrients (e.g., potassium chloride) in the formulation will result in errors. System reports should document the specific food items and amounts employed in any recipe calculation.

A critical issue on use of data bases is missing nutrient values in the data files. This source of error probably accounts for the greatest number of inaccuracies in recipe calculations. Missing values are usually calculated as "zero," and some available systems do not flag such calculated values in printed reports (i.e., mark a calculated nutrient value to show that the nutrient was missing for a least one ingredient used in the

recipe), so that the user might not be aware of the situation. Any user should know when calculated values are underestimated and adjustments are necessary because serious errors can result. Vendors should be able to provide customers with information on the percent of missing nutrient values in the data base, whether missing values are identified as such, and whether the software distinguishes between missing values and true "zeroes," which may be blank fields.

It has to be recognized that when brand name and uncommon ingredients are added to data bases, the information provided may not be complete for all of the nutrients required under the new labeling rule. As noted previously, sugars currently are not contained in USDA's large nutrient files and may be missing from data bases to which they have not been added by the developer. Dietary fiber (not to be confused with crude fiber) is another mandatory nutrient for which values may not be complete in a number of systems or may only represent the insoluble fraction. It should be noted that a missing nutrient that is not present in a food, e.g., dietary fiber in meat, does not present a problem. A number of data base developers do attempt to locate analytical data to fill in missing values or replace them with calculated or "imputed" numbers. Customers should ask about missing values and the extent of imputation of values for ingredients they need to use that are sources of nutrients.

3. <u>Specificity for food descriptions and processing</u>. Foods included in a data base should be described with sufficient detail so that it is possible to link a recipe ingredient with the appropriate data base entry. Inappropriate selections that could lead to errors might include interchanging raw and cooked food in a simple additive calculation, replacing an unfortified ingredient with its fortified form when the added nutrient is one that would be labeled, and substituting a low-sodium version of a product in a recipe for its regular counterpart. Data bases should offer some flexibility in terms of describing foods so they can be retrieved easily using common terminology, e.g., by percent fat, by cut of meat, or by common name. Likewise, data bases should offer flexibility for describing amounts to be entered in standard units of weight or volume. It would be worthwhile to know if amounts can be defined as the amount before or after cooking, with or without refuse like bone, or by form, such as chopped or grated.

System specificity must extend to the processes employed in the manufacture of products, i.e., yield and nutrient adjustments must be made to account for changes occurring during processing. Such adjustments include those for edible weights vs. recipe weights of foods with inedible parts like bones; moisture changes due to evaporation or absorption during processing; fat changes such as loss to drippings on cooking of meat or poultry or pickup during frying in oil; heat destruction of labile nutrients such

as vitamin C; losses of water-soluble vitamins and minerals that might leech into cooking water during boiling; and, uptake of sodium from salted water. Manufacturers need the ability to accommodate their specific product yields due to the unique nature of processing and cooking procedures for individual products. They should determine what procedures are employed by any system they have under consideration and if the programming logic has been validated. Information about methods for recipe calculation should be provided with a system's documentation.

RECIPE CALCULATION PROCEDURES

There is no one standard method for performing a recipe calculation, and data base systems do use several different approaches. Basic general steps in a calculation are as follows:

1. Determine the weight in grams of each ingredient in the formulation and subtract the weight of inedible parts of each ingredient.

2. Determine the nutrients in the specified edible portion weight of each ingredient from a nutrient data file.

3. Apply retention factors to vitamin and mineral values for the ingredients to correct them for losses occurring during cooking. Standard nutrient retention factor files might be used for this purpose if they are applicable to the product and process, or product specific data should be used when standardized values will not apply.

4. Determine the total uncooked weight of the recipe by adding the weights of the ingredients.

5. Determine the levels of nutrients in the recipe by adding the corrected nutrient values for the ingredients.

6. Using specific plant yield information for the product, adjust the total values for the uncooked recipe weight and the nutrients to account for moisture loss or gain and fat loss or gain. When adjusting for fat changes, subtract or add, as appropriate, all nutrients contained in that fat, e.g., kilocalories, fatty acids, cholesterol, and fat soluble vitamins, if present.

7. Convert the nutrient values for the total recipe after water and fat adjustments are made to the per-serving weight in grams.

Methods commonly employed by computerized nutrient calculation systems include, but are not limited to, the following types:

- Applying vitamin and mineral retention factors to each nutrient in each raw ingredient, adding the corrected nutrient values for the ingredients, and adjusting the final recipe

mixture for moisture and fat changes as described under the general steps above. This procedure accounts for both weight changes and nutrient losses or gains.

- Converting the weights of raw ingredients to their cooked weights in the recipe and adding the nutrient values for the cooked forms of the raw ingredients. This procedure also accounts for changes in weight and nutrient values and avoids use of retention factors if data on the appropriate cooked form of each ingredient are available.

- Adding nutrient data for raw ingredients to compute the total recipe, adjusting the entire recipe weight to a cooked weight, and applying vitamin retentions to the final mixture. This procedure requires specific knowledge of the recipe yield and nutrient losses for the entire mixture, ignores losses of minerals, and requires new yield and retention factors with formulation changes.

- Adding the nutrient values for raw ingredients after converting them to their final cooked weight in the recipe. This procedure accounts only for the weight changes, generally underestimates nutrient values, and does not systematically account for losses due to heat and other factors.

- Adding the nutrient values for raw ingredients described in a recipe. This is only acceptable for uncooked recipes and would overestimate the amounts of some nutrients in cooked recipes that are partially lost in cooking.

There are procedural advantages and disadvantages to all of these methods. Because any approach employed can influence the final nutrient values for a recipe, manufacturers need to be aware of how the computations are performed and ascertain if they are suitable for their particular products and processes.

GUIDELINES FOR EFFECTIVE USE

Whether a manufacturer chooses to perform his or her own in-house calculations for the nutrient content of products or contract for this service, FSIS believes the following general guidelines are applicable for effective use of data bases.

1. <u>Preferably use recipe analysis to generic values</u>. Unless processors are fairly sure their particular products are very similar in formulation to generic items, e.g., a frankfurter, they should not select such data base items to represent their products. It is preferable to calculate values for products based on their unique formulations and specific plant yields.

2. <u>Use data base ingredients that are appropriate</u>. It is very tempting to use existing data base entries for "similar"

materials when, in fact, the ingredient used is not truly all that similar. If an appropriate match for an important ingredient is not in a data base, try to obtain the information from the supplier or other sources. If an ingredient contains no required nutrients, do not ignore its contribution to the weight of the formula.

3. Use exact formula quantities. Processors will have an increased responsibility to assure appropriate uniformity from batch to batch and to determine when a new estimation is needed due to changes in ingredient composition or processing method. Base final values on actual edible portion weight and not on the net weight of the product.

4. Make yield adjustments. Find out what losses will occur in preparation or cooking. If the recipe weight includes any inedible parts, determine the edible weight. It is also important to know the cooked yield of the product. Simple weighings can be used to establish these yield factors.

5. Track moisture and fat changes. Determine if water is lost through evaporation or draining or absorbed during processing, and if fat is lost to drippings and discarded. Changes in these two components affect both the final yield and nutrient composition. Most manufacturers recommend laboratory analysis for these nutrients because they are variable in finished products and their analysis is relatively inexpensive.

6. Be careful with fried foods. Fat absorption during frying varies with a number of factors, such as type of food and coating. Determining fat absorption usually requires before and after cooking analysis for fat to establish the amount typically absorbed by a particular product. Once determined, calculating values for future products requires knowledge of the level of saturation of the cooking oils.

7. Do not ignore missing nutrient values. If required nutrients are present in significant amounts in an important ingredient of a product but are missing in the data base, try to obtain that information from the supplier or from other sources.

8. Adjust for losses of micronutrients. Data bases generally use standard retention factors for different cooking methods. Manufacturers should determine if they have special processing losses, especially with regard to sodium, which was frequently mentioned as a variable nutrient.

9. Check the calculations for reasonableness. Compare final values to analytical data on the particular product or data on comparable products from other sources. Try to reconcile discrepencies. Combinations of data base and lab analysis, if only for check nutrients, ensure the most accurate results.

COMPOSITE NUTRIENT DATA FOR MEAT AND POULTRY PRODUCTS

Frequently, processed meat products are made using lean and fat trimmings. Specific cuts are not identified so that composite values can be used to develop nutrient profiles of mixes of lean and fat in a meat block at targeted fat percentages. Because these values might have wide use for certain product types, they are shown below for separable lean and separable fat tissues of red meats (new pork values) and poultry with and without skin as listed in AH-8 with the identifying NDB No. Dietary fiber and sugars contents are zero for all items. Total calories were calculated using protein X 4.27 plus fat X 9.02.

	Beef, Raw		Pork, Raw		Lamb, Raw	
	Lean	Fat	Lean	Fat	Lean	Fat
NDB No.	13011	13019	10228	10006	17003	17005
	(Amount in 100 grams, edible portion)					
Moisture (g)	70.62	20.21	72.23	24.59	73.42	22.54
Calories (kcal)	144	674	144	638	134	665
Protein (g)	20.78	8.21	21.23	6.34	20.29	6.65
Total Fat (g)	6.16	70.89	5.88	67.70	5.25	70.61
Total Carb. (g)	0	0	0	0	0	0
Ash (g)	1.02	0.28	1.05	0.25	1.06	0.36
Saturated Fat (g)	2.32	29.45	2.03	23.52	1.88	32.24
Cholesterol (mg)	59	99	60	93	65	90
Sodium (mg)	63	29	54	18	66	31
Calcium (mg)	6	10	17	45	10	19
Iron (mg)	2.13	0.75	0.88	0.29	1.77	0.98
Vitamin A (IU)	0	0	7	10	0	0
Vitamin C (mg)	0	0	0.6	0	0	0

	Veal, Raw		Chicken, Raw		Turkey, Raw	
	Lean	Fat	Flesh	w Skin	Flesh	w Skin
NDB No.	17090	17092	05011	05006	05167	05165
	(Amount in 100 grams, edible portion)					
Moisture (g)	75.91	24.77	75.46	65.99	74.16	70.40
Calories (kcal)	112	638	119	215	119	160
Protein (g)	20.20	6.02	21.39	18.60	21.77	20.42
Total Fat (g)	2.87	67.83	3.08	15.06	2.86	8.02
Total Carb. (g)	0	0	0	0	0	0
Ash (g)	1.08	0.43	0.96	0.79	0.97	0.88
Saturated Fat (g)	0.86	32.92	0.79	4.31	0.95	2.26
Cholesterol (mg)	83	73	70	75	65	68
Sodium (mg)	86	26	77	70	70	65
Calcium (mg)	15	7	12	11	14	15
Iron (mg)	0.85	0.60	0.89	0.90	1.45	1.43
Vitamin A (IU)	0	0	52	140	0	6
Vitamin C (mg)	0	0	2.3	1.6	0	0

Values for the same tissues are also shown below for their cooked forms. For the red meats, each component cut that makes up the composite was cooked by a popular method for the specific cut so that the values do not represent any one specific cooking method.

	Beef, Cooked		Pork, Cooked		Lamb, Cooked	
	Lean	Fat	Lean	Fat	Lean	Fat
NDB No.	13012	13020	10229	10007	17004	17006
	(Amount in 100 grams, edible portion)					
Moisture (g)	59.29	18.58	60.30	23.22	61.96	26.14
Calories (kcal)	216	680	211	629	206	586
Protein (g)	29.58	10.65	29.47	12.20	28.22	12.16
Total Fat (g)	9.91	70.33	9.44	63.92	9.52	59.18
Total Carb. (g)	0	0	0	0	0	0
Ash (g)	1.20	0.45	1.19	0.75	1.14	0.68
Saturated Fat (g)	3.79	28.50	3.34	24.49	3.40	27.02
Cholesterol (mg)	86	95	85	93	92	114
Sodium (mg)	67	41	57	34	76	58
Calcium (mg)	9	14	22	53	15	23
Iron (mg)	2.99	1.06	1.07	0.36	2.05	1.29
Vitamin A (IU)	0	0	7	13	0	0
Vitamin C (mg)	0	0	0.4	0	0	0

	Veal, Cooked		Chicken, Roast		Turkey, Roast	
	Lean	Fat	Flesh	w Skin	Flesh	w Skin
NDB No.	17091	17093	05013	05009	05168	05166
	(Amount in 100 grams, edible portion)					
Moisture (g)	60.16	21.65	63.79	59.45	64.88	61.70
Calories (kcal)	196	642	190	239	170	208
Protein (g)	31.90	9.42	28.93	27.30	29.32	28.10
Total Fat (g)	6.58	66.74	7.41	13.60	4.97	9.73
Total Carb. (g)	0	0	0	0	0	0
Ash (g)	1.23	0.82	1.02	0.92	1.05	1.00
Saturated Fat (g)	1.84	32.39	2.04	3.79	1.64	2.84
Cholesterol (mg)	118	73	89	88	76	82
Sodium (mg)	89	57	86	82	70	68
Calcium (mg)	24	4	15	15	25	26
Iron (mg)	1.16	1.00	1.21	1.26	1.78	1.79
Vitamin A (IU)	0	0	53	161	0	0
Vitamin C (mg)	0	0	0	0	0	0

Because the total carbohydrate content of fresh, single-ingredient products (except organ meats) is so small as to be practically negligible, it is always assigned a zero value. The sum of the percentages of water, protein, total fat, and ash does not necessarily equal exactly 100 percent for these nutrients because each proximate constituent is determined independently.

CONCLUSIONS

FSIS strongly supports the development and use of modern data bases for nutrition labeling. As previously noted, FSIS believes that use of data bases, alone or in conjunction with analytical testing, can facilitate cost effective development of accurate nutrient declarations for meat and poultry products. Responsible use of a data base will produce values that meet the requirements of the nutrition labeling regulations and provide consumers with highly useful information. FSIS encourages firms to exercise fully their prerogative to use data bases to construct labels reflecting the average nutrient levels in their products over time. It also encourages those who choose to do so to make their analytical information available to USDA's National Nutrient Data Bank where it may benefit a wide range of users.

Regarding compliance with the regulations, FSIS wants to stress that it is not its intent to proceed in a punitive manner against companies if problems should arise during compliance testing. FSIS does hold all manufacturers, whether they use direct analysis or data bases, to the same compliance parameters. In the event of problems, FSIS will review company records and work with the firms responsible for the product in question, including products based on data bases or recipe analysis, to locate the source of any problem so that it can be corrected.

REFERENCES

(1) Beecher, G.R. 1990. Sources of Variability in the Carotenoid Level and Vitamin A Activity of Foods. *Proc. 15th Natl. Nutrient Databank Conf.*, pp. 33-42. The CBORD Group, Inc., Ithaca, NY.

(2) U. S. Department of Agriculture. May 1992. Machine-Readable Data Sets on Composition of Foods and Results from Food Consumption Surveys. Human Nutrition Information Service Administrative Report No. 378. Hyattsville, MD.

(3) Nieman, D.C., D.E. Butterworth, C.N. Nieman, K.E. Lee, and R.D. Lee. 1992. Comparison of six microcomputer dietary analysis systems with the USDA Nutrient Data Base for Standard Reference. *J. Am. Diet. Assoc.*, 92:48-56.

APPENDIX

Table 1. USDA Food Composition Publications

Agriculture Handbook No. 8 Series

SERIES	TITLE	DATE	GPO STOCK NO.	PRICE
AH-8-1	Dairy and Egg Products	1976	001-000-03635-1	$9.00
AH-8-2	Spices and Herbs	1977	001-000-03646-7	3.75
AH-8-3	Baby Foods	1978	001-000-03900-8	12.00
AH-8-4	Fats and Oils	1979	001-000-03984-9	7.50
AH-8-5	Poultry Products	1979	001-000-04008-1	17.00
AH-8-6	Soups, Sauces, and Gravies	1980	001-000-04114-2	12.00
AH-8-7	Sausages and Luncheon Meats	1980	001-000-04183-5	6.00
AH-8-8	Breakfast Cereals	1982	001-000-04283-1	9.00
AH-8-9	Fruits and Fruit Juices	1982	001-000-04287-4	14.00
AH-8-10	Pork Products	1992	001-000-04593-8	14.00
AH-8-11	Vegetables and Vegetable Products	1984	001-000-04427-3	16.00
AH-8-12	Nut and Seed Products	1984	001-000-04429-0	7.50
AH-8-13	Beef Products	1990	001-000-04555-5	21.00
AH-8-14	Beverages	1986	001-000-04468-1	9.50
AH-8-15	Finfish and Shellfish Products	1987	001-000-04497-4	10.00
AH-8-16	Legumes and Legume Products	1986	001-000-04488-5	8.50
AH-8-17	Lamb, Veal, and Game Products	1989	001-000-04541-5	13.00
AH-8-18	Baked Products	1992	001-000-04584-9	28.00
AH-8-19	Snacks and Sweets	1991	001-000-04577-6	19.00
AH-8-20	Cereal Grains and Pasta	1989	001-000-04549-1	8.50
AH-8-21	Fast Foods	1988	001-000-04524-5	11.00
AH-8	Composition of Foods...Raw, Processed, Prepared.*			
	1989 Supplement	1990	001-000-04554-7	11.00
	1990 Supplement	1991	001-000-04571-7	17.00
	1991 Supplement	1992	001-000-04585-7	12.00

* Supplements update selected items, add data for new food items, and add tables of data on selected nutrients.

OTHER

HERR-48	Sugar Content of Selected Foods: Individual and Total Sugars	1987	001-000-04514-8	2.00

Order from the Government Printing Office (GPO) as follows:

By mail. Make check or money order payable to "Superintendent of Documents," or use Government Printing Office Deposit Account. Mail to: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

By telephone. Use VISA or Mastercard credit cards or Government Printing Office Deposit Account. Call (202) 783-3238.

By telefax. Call (202) 275-0019, anytime.

By visiting or calling a GPO bookstore as follows:

ALABAMA--Birmingham: O'Neill Bldg., 2021 3rd Ave., North 35203 (205) 731-1056

CALIFORNIA--Los Angeles: ARCO Plaza-Level C, 505 S. Flower St. 90071 (213) 239-9844

San Francisco: Rm. 1023, Federal Office Bldg., 450 Golden Gate Ave. 94102 (415) 252-5334

COLORADO--Denver: Rm. 117, Federal Bldg., 1961 Stout St. 80294 (303) 844-3964

Pueblo: World Savings Bldg., 720 N. Main St. 81003 (714) 544-3142

DISTRICT OF COLOMBIA--710 North Capitol St., NW 20402 (202) 512-0132; and, 1717 H St., NW 20005 (202) 653-5075

FLORIDA--Jacksonville: P.O. Box 35089, Federal Bldg., 400 W. Bay St. 32202 (904) 353-0569

GEORGIA--Atlanta: P.O. Box 56445, 275 Peachtree St., NE 30343 (404) 331-6947

ILLINOIS--Chicago: Rm. 1365, Dirksen Bldg., 219 S. Dearborn St. 60604 (312) 353-5133

MARYLAND--Laurel: Laurel Bookstore, 8660 Cherry Lane 20707 (301) 953-7974

MASSACHUSETTS--Boston: Rm. 169, O'Neill Federal Bldg., 10 Causeway St. 02222 (617) 720-4180

MICHIGAN--Detroit: Suite 160, McNamara Federal Bldg., 477 Michigan Ave. 48226 (313) 226-7816

MISSOURI--Kansas City: 120 Bannister Mall, 5600 E. Bannister Rd. 64137 (816) 765-2256

NEW YORK--New York: Rm. 110, 26 Federal Plaza 10278 (212) 264-3825

OHIO--Cleveland: Rm. 1653, Federal Office Bldg., 1240 E. 9th St. 44199 (216) 522-4922

Columbus: Rm. 207, Federal Bldg., 200 N. High St., 43215 (614) 469-6956

OREGON--Portland: 1305 S.W. First Ave. 97201 (503) 221-6217

PENNSYLVANIA--Philadelphia: Morris Bldg., 100 N. 17th St. 19103 (215) 597-0677

Pittsburgh: Rm. 118, Federal Bldg., 1000 Liberty Ave. 15222 (412) 644-2721

TEXAS--Dallas: Suite 1C46, Federal Bldg., 1100 Commerce St. 75242 (214) 767-0076

Houston: Texas Crude Bldg., 801 Travis St. 77002 (713) 228-1187

WASHINGTON--Seattle: Rm. 194, Federal Office Bldg., 915 Second Ave. 98174 (206) 442-4270

WISCONSIN--Milwaukee: Rm. 190, Federal Bldg., 517 E. Wisconsin Ave. 53202 (414) 297-1304

Table 2. Nutrient Data Bank Electronic Bulletin Board Files

Files for Downloading

1. USDA Nutrient Data Base for Standard Reference, Release 10
   Release 10 contains all of the nutrient data on all foods published in the complete 21 volumes of the AH-8 series, including the Pork Section published in February 1993. Some, but not all, of the missing values contained in the published versions have been filled in by HNIS staff. The files include raw and cooked forms of food and contain about 5,500 entries.

2. Survey Nutrient Data Base, Release 5
   Release 5 contains nutrient data used in the 1989 USDA Continuing Survey of Food Intakes by Individuals. Files contain many items that are calculated from recipes and do not correspond to any published food composition table. Values for meat and poultry products are for cooked forms of the food. The data base contains about 6,500 foods.

3. Primary Data Set for Standard Reference, Release 5
   Release 5 contains nutrient values for foods used to create the Survey Nutrient Data Base, including raw foods used in calculating the recipe items and certain ingredients such as baking powder, which do not appear in AH-8. The file does not contain all foods in AH-8 but holds about 3,000 items.

4. USDA Table of Nutrient Retention Factors, Release 3
   Release 3 contains retention factors for 18 vitamins and minerals for 260 foods used in recipe calculations for the survey data base. It does not contain many of the specific retention factors shown for the individual cuts of meat and poultry products as published in the hard copy versions of the AH-8 series.

5. Recipes for the Survey Data Base, Release 5
   This file contains the component records of the recipes used to create the survey data base, e.g., yields for recipes, moisture and fat changes, and retention factor codes.

6. Sugar
   The sugar file contains data from the Home Economic Research Report No. 48, which was published in 1987. It includes data on mono- and disaccharides, other sugars, and total sugars for over 500 foods. More information on sugar content of foods may be obtained from HNIS at (301) 436-8491.

The board also contains a file of nutrient data on about 900 foods from Home and Garden Bulletin No. 72, a Dietary Analysis Program for the PC, data on vitamins K and D, and data on the nutrient content of the U.S. food supply.

Table 3. Commercial Nutrient Calculation Systems *

Organizations, system names, and contacts

Organization	System name and contact
CAMDE Corporation .... 4435 S. Rural Road Suite 331 Tempe, AZ 85282	Nutri-Calc HD and Plus Contact: Julie McDonald (602) 821-2310
Case Western Reserve University School of Medicine 2109 Adelbert Road Cleveland, OH 44106-4945	HVH-CWRU Nutrient Data Base Contact: Harold Houser (216) 368-3195
The CBORD Group, Inc. .... 61 Brown Road Ithaca, NY 14850	Diet Analyzer System Contact: Nancy Vergara (607) 257-2410
Computrition, Inc. .... P.O. Box 4689 Chatsworth, CA 91313-4689	Nutritional Software Library Contact: Bridgett Harvey-Elliott (818) 701-5544
DDA Software .... P.O. Box 26 Hamburg, NJ 07419	Nutrient Analysis System 2 Contact: Carl Bredbenner, Jr. (201) 764-6677
DINE Systems, Inc. .... 586 N. French Road Suite 2 Amherst, NY 14228	The DINE System: Nutrient Analysis (DINE Windows, Macdine II) Contact: Kathryn Dennison (716) 688-2492
ESHA Research .... P.O. Box 13028 Salem, OR 97309-9730	Food Processor II and Genesis Contact: Patricia Bishop (503) 585-6242
Formulas/Now! Software......... 2755 Chelsea Drive Suite A Oakland, CA 94611-2505	Formulas Now Contact: Jerry Salzman (510) 482-2705
Hopkins Technology .... 421 Hazel Lane Hopkins, MN 55343-7116	Food/Analyst Plus Contact: Phillip Dunn (612) 931-9376
N-Squared Computing .... Analytic Software 3040 Commercial St., SE Suite 240 Salem, OR 97302	Nutritionist III and IV Contact: Laurie North (503) 364-9118

Nutrition and Food Associates . P.O. Box 47007 Minneapolis, MN 55447	NutriForm Contact: Patricia Godfrey (612) 550-9475
Palatino Products .... P.O. Box 20452 Castro Valley, CA 94546	Kwik-answer Contact: George Shaw (510) 538-0132
Practorcare, Inc. .... 10951 Sorrento Valley Road Suite 2F San Diego, CA 92121	Nutriplanner Contact: Barbara Harris (800) 421-9073
University of Minnesota .... Nutrition Coordinating Center 2221 University Ave., S.E. Suite 310 Minneapolis, MN 55414-3076	Minnesota Nutrition Data System Contact: Keren Price (612) 627-4869
University of Texas .... Health Science Center School of Public Health P.O. Box 20186 Houston, TX 77225	Food Intake Analysis System Contact: Deirdre Douglass (713) 792-4533
Wellsource, Inc. .... P.O. Box 569 Clackamas, OR 97015	Professional Dietitian Contact: Donald Hall (503) 656-7446
WholeGrain Software .... 1427 Bancroft Way Berkeley, CA 94702	NutriLabeler Contact: David Stone (415) 848-5903

* Mention of commercial products is solely for identification purposes to report factually on available information and does not constitute endorsement by USDA. USDA neither evaluates nor approves nutrient calculation systems and neither guarantees nor warrants the quality of the listed products. Use of brand names by USDA implies no approval of the products to the exclusion of others which may also be suitable.